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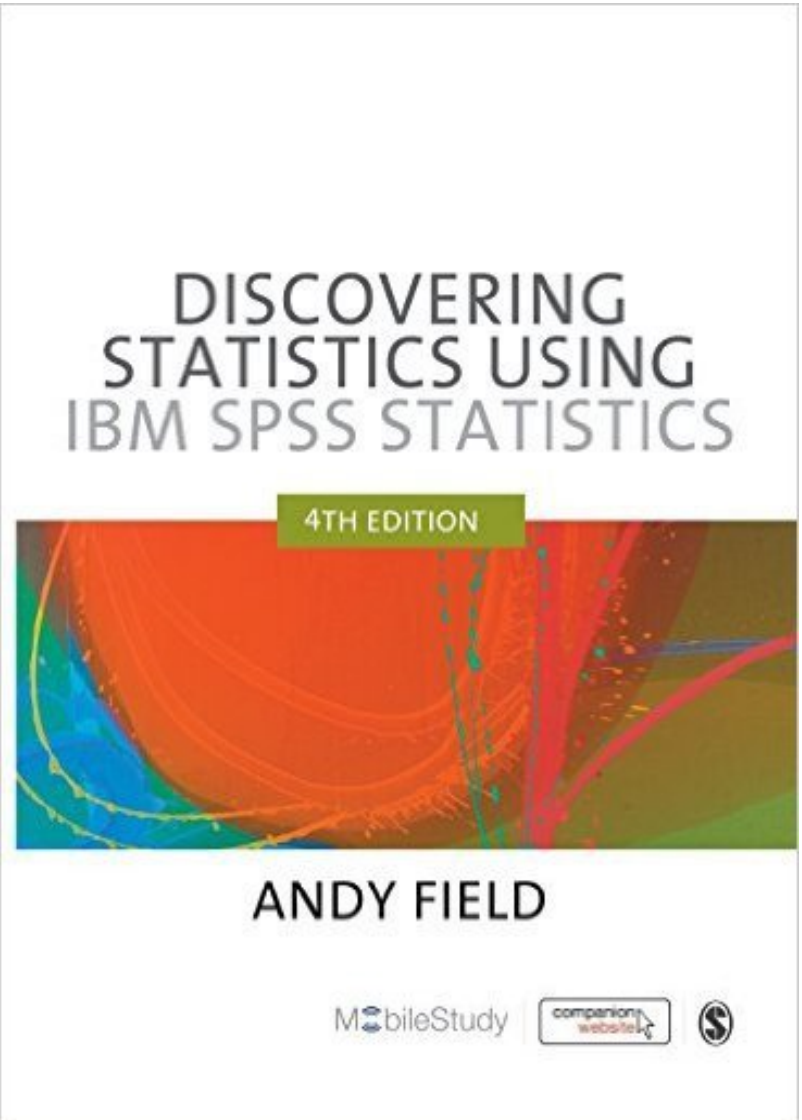

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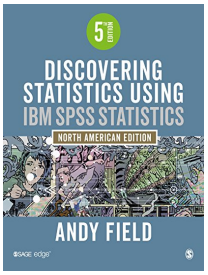

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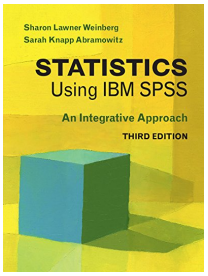

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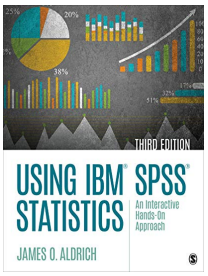

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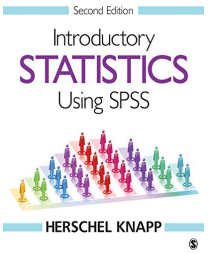

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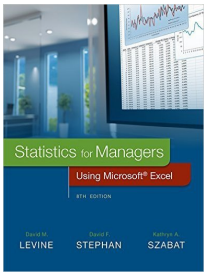

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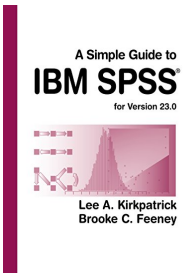

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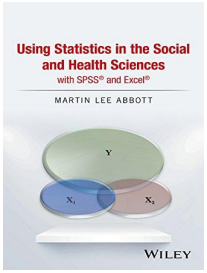

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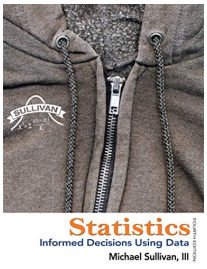

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PREFACE

Karma Police, arrest this man, he talks in maths, he buzzes like a fridge, he's like a detuned radio

Radiohead, 'Karma Police', *OK Computer* (1997)

Introduction

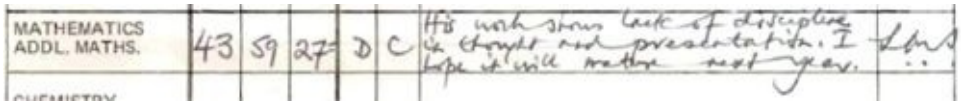
Many behavioural and social science students (and researchers for that matter) despise statistics. Most of us have a non-mathematical background, which makes understanding complex statistical equations very difficult. Nevertheless, the evil goat-warriors of Satan force our non-mathematical brains to apply themselves to what is the very complex task of becoming a statistics expert. The end result, as you might expect, can be quite messy. The one weapon that we have is the computer, which allows us to neatly circumvent the considerable disability of not understanding mathematics. Computer programs such as IBM SPSS Statistics, SAS, R and the like provide an opportunity to teach statistics at a conceptual level without getting too bogged down in equations. The computer to a goat-warrior of Satan is like catnip to a cat: it makes them rub their heads along the ground and purr and dribble ceaselessly. The only downside of the computer is that it makes it really easy to make a complete idiot of yourself if you don't really understand what you're doing. Using a computer without any statistical knowledge at all can be a dangerous thing. Hence this book.

My first aim is to strike a good balance between theory and practice: I want to use the computer as a tool for teaching statistical concepts in the hope that you will gain a better understanding of both theory and practice. If you want theory and you like equations then there are certainly better books: Howell (2012), Stevens (2002) and Tabachnick and Fidell (2012) have taught (and continue to teach) me more about statistics than you could possibly imagine. (I have an ambition to be cited in one of these books, but I don't think that will ever happen.) However, if you want a stats book that also discusses digital rectal stimulation then you have just spent your money wisely.

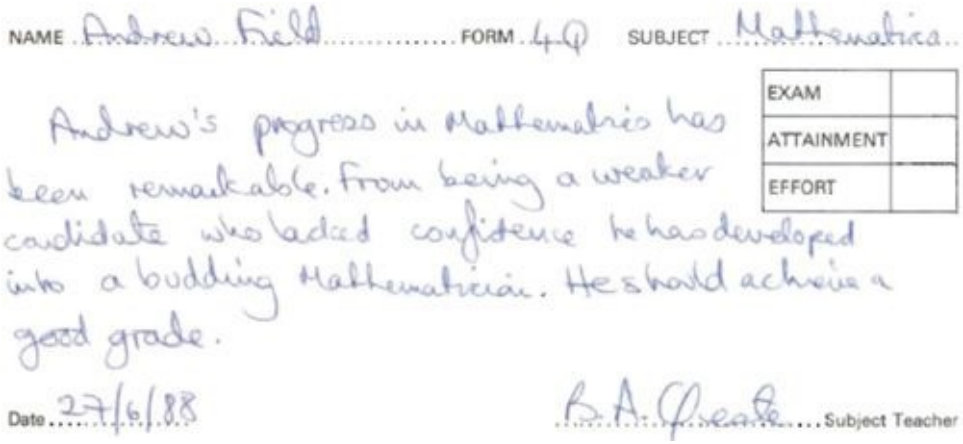
Too many books create the impression that there is a 'right' and 'wrong' way to do statistics. Data analysis is more subjective than is often made out. Therefore, although I make recommendations, within the limits imposed by the senseless destruction of rainforests, I hope to give you enough background in theory to enable you to make your own decisions about how best to conduct your analysis.

A second (ridiculously ambitious) aim is to make this the only statistics book that you'll ever need to buy. It's a book that I hope will become your friend from first year at university right through to your professorship. The start of the book is aimed at first-year undergraduates (Chapters 1–9), and then we move onto second-year undergraduate level material (Chapters 5, 8 and 10–15) before a dramatic climax that should keep postgraduates tickled (Chapters 16–20). There should be something for everyone in each chapter also, and to help you gauge the difficulty of material, I flag the level of each section within each chapter (more on that in a moment).

My final and most important aim is to make the learning process fun. I have a sticky history with maths. This extract is from my school report at the age of 11:



The ‘27’ in the report is to say that I came equal 27th with another student out of a class of 29. That’s pretty much bottom of the class. The 43 is my exam mark as a percentage. Oh dear. Four years later (at 15) this was my school report:


NAME Andrew Field FORM 4Q SUBJECT Mathematics
EXAM
ATTAINMENT
EFFORT
Andrew's progress in Mathematics has been remarkable. From being a weaker candidate who lacked confidence he has developed into a budding Mathematician. He should achieve a good grade.
Date 27/6/88
Subject Teacher

The catalyst of this remarkable change was having a good teacher: my brother, Paul. I owe my life as an academic to Paul’s ability to teach me stuff in an engaging way – something my maths teachers failed to do. Paul’s a great teacher because he cares about bringing out the best in people, and he was able to make things interesting and relevant to me. He got the ‘good teaching’ genes in the family, but wasted them by not becoming a teacher; however, they’re a little less wasted because his approach inspires mine. I strongly believe that people appreciate the human touch, and so I try to inject a lot of my own personality and sense of humour (or lack of) into *Discovering Statistics Using …* books. Many of the examples in this book, although inspired by some of the craziness that you find in the real world, are designed to reflect topics that play on the minds of the average student (i.e., sex, drugs, rock and roll, celebrity, people doing crazy stuff). There are also some examples that are there simply because they made me laugh. So, the examples are light-hearted (some have said ‘smutty’, but I prefer ‘light-hearted’) and by the end, for better or worse, I think you will have some idea of what goes on in my head on a daily basis. I apologize to those who think it’s crass, hate it, or think that I’m undermining the seriousness of science, but, come on, what’s not funny about a man putting an eel up his anus?

I never believe that I meet my aims, but previous editions have certainly been popular. I enjoy the rare luxury of having complete strangers emailing me to tell me how wonderful I am. (Admittedly, there are also emails calling me a pile of gibbon excrement, but you have to take the rough with the smooth.) The second edition of this book also won the British Psychological Society book award in 2007. However, with every new edition, I fear that the changes I make will ruin all of my previous hard work. Let’s see what those changes are.

What do you get for your money?

This book takes you on a journey (and I try my best to make it a pleasant one) not just of statistics but also of the weird and wonderful contents of the world and my brain. It’s full of daft, bad jokes, and smut. Aside from the smut, I have been forced reluctantly to include some academic content. In essence it contains everything I know about statistics (actually, more than I know …). It also has these features:

- **Everything you'll ever need to know**: I want this book to be good value for money, so it guides you from complete ignorance (Chapter 1 tells you the basics of doing research) to being an expert on multilevel modelling (Chapter 20). Of course no book that it's physically possible to lift will contain everything, but I think this one has a fair crack. It's pretty good for developing your biceps also.
- **Stupid faces:** You'll notice that the book is riddled with stupid faces, some of them my own. You can find out more about the pedagogic function of these 'characters' in the next section, but even without any useful function they're nice to look at.
- **Data sets**: There are about 132 data files associated with this book on the companion website. Not unusual in itself for a statistics book, but my data sets contain more sperm (not literally) than other books. I'll let you judge for yourself whether this is a good thing.
- **My life story:** Each chapter is book-ended by a chronological story from my life. Does this help you to learn about statistics? Probably not, but hopefully it provides some light relief between chapters.
- **SPSS tips**: SPSS does weird things sometimes. In each chapter, there are boxes containing tips, hints and pitfalls related to SPSS.
- **Self-test questions**: Given how much students hate tests, I thought the best way to commit commercial suicide was to liberally scatter tests throughout each chapter. These range from simple questions to test what you have just learned to going back to a technique that you read about several chapters before and applying it in a new context. All of these questions have answers to them on the companion website so that you can check on your progress.
- **Companion website**: The companion website contains an absolutely insane amount of additional material, all of which is described in the section about the companion website.
- **Digital stimulation**: No, not the aforementioned type of digital stimulation, but brain stimulation. Many of the features on the companion website will be accessible from tablets and smartphones, so that when you're bored in the cinema you can read about the fascinating world of heteroscedasticity instead.
- **Reporting your analysis**: Every chapter has a guide to writing up your analysis. How you write up an analysis varies a bit from one discipline to another, but my guides should get you heading in the right direction.
- **Glossary**: Writing the glossary was so horribly painful that it made me stick a vacuum cleaner into my ear to suck out my own brain. You can find my brain in the bottom of the vacuum cleaner in my house.
- **Real-world data**: Students like to have 'real data' to play with. The trouble is that real research can be quite boring. However, just for you, I trawled the world for examples of research on really fascinating topics (in my opinion). I then stalked the authors of the research until they gave me their data. Every chapter has a real research example.

What do you get that you didn't get last time?

I suppose if you have spent your hard-earned money on the previous edition it's reasonable that you want a good reason to spend more money on this edition. In some respects it's hard to quantify all of the changes in a list: I'm a better writer than I was 4 year ago, so there is a lot of me rewriting things because I think I can do it better than before. I spent 6 months solidly on the updates, so suffice it to say that a lot has changed; but anything you might have liked about the previous edition probably hasn't

changed:

- **IBM SPSS compliance**: This edition was written using versions 20 and 21 of IBM SPSS Statistics. IBM bring out a new SPSS each year and this book gets rewritten about every 4 years, so, depending on when you buy the book, it may not reflect the latest version. This shouldn't bother you because one edition of SPSS is usually much the same as another (see Section 3.2).
- **New! Mediation and Moderation**: Even since the first edition I have been meaning to do a chapter on mediation and moderation, because they are two very widely used techniques. With each new edition I have run out of energy. Not this time though: I wrote it in the middle of the update before I managed to completely burn myself out. Chapter 10 is brand spanking new and all about mediation and moderation.
- **New! Structure**: My publishers soiled their underwear at the thought of me changing the structure because they think lecturers who use the book don't like this sort of change. They might have a point, but I changed it anyway. So, logistic regression (a complex topic) has moved towards the end of the book, and non-parametric tests (a relatively straightforward topic) have moved towards the beginning. In my opinion this change enables the book's story to flow better.
- **New! Focus**: Statistical times are a-changing, and people are starting to appreciate the limitations of significance testing, so I have discussed this more in Chapter 2, and the points made there permeate the rest of the book. The theme of 'everything being the same model' has run through all editions of the book, but I have made this theme even more explicit this time.
- **New! Tasks**: There are 111 more Smart Alex tasks, and 8 more Labcoat Leni tasks. This, of course, means there are quite a lot more pages of answers to these tasks on the companion website.
- **New! Bootstrapping**: The SPSS bootstrapping procedure is covered in every chapter where it is relevant.
- **New! Process diagrams**: Every chapter has a diagrammatic summary of the key steps that you go through for a particular analysis.
- **New! Love story**: Every chapter has a diagrammatic summary at the end (*Brian's attempt to woo Jane*). More interesting, though, Brian Haemorrhage has fallen in love with Jane Superbrain (see next section) and these diagrams follow Brian's attempts to convince Jane to go on a date with him.
- **New! Characters**: I enjoy coming up with new characters, and this edition has a crazy hippy called Oditi, and a deranged philosopher called Confusius (see the next section).
- **New-ish! Assumptions**: I've never really liked the way I dealt with assumptions, so I completely rewrote Chapter 5 to try to give more of a sense of when assumptions actually matter.

Every chapter had a serious edit/rewrite, but here is a chapter-by-chapter run-down of the more substantial changes:

- **Chapter 1 (Doing research)**: I added some more material on reporting data. I added stuff about variance and standard deviations, and expanded the discussion of *p*-values.
- **Chapter 2 (Statistical theory)**: I added material on estimating parameters, significance testing and its limitations, problems with one-tailed tests, running multiple tests (i.e., familywise error), confidence intervals and significance, sample size and significance, effect sizes (including Cohen's *d* and meta-analysis), and reporting basic statistics. It's changed a lot.
- **Chapter 3 (IBM SPSS)**: No dramatic changes.
- **Chapter 4 (Graphs)**: I moved the discussion of outliers into Chapter 5, which meant I had to rewrite one of the examples. I now include population pyramids also.

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when, as in the case of Laokoön, the mortal wound is received only after the most exhausting struggle, the natural expression is moaning. The realistic sculptor would surely not give any softened form, but, shrinking from nothing, has expressed Laokoön in this death grasp in the very act of giving up the ghost. Though the muscles of the limbs and trunk are still tense, yet the closing eyes, the head falling back, and the arm thrown toward the base of the brain indicate that the struggle is over, and the death moment has come, expressed vocally only by a moan. We do not need to find here then any conflict between realism and the artistic sense, but the simplest and most obvious interpretation is what the expression gives, sighing and moaning, which is the true one under the circumstances, and is so meant by the artist.

CHAPTER XXI

CONCLUSION

In the present haste to construct psychology as a natural science cognate to chemistry, physics, and biology, we note much that is premature and confusing, owing to insufficient reflection upon the quality of the phenomena. A consciousness is a natural phenomenon, but we cannot discover and investigate it as we do phenomena of light and electricity. Anger is a phenomenon occurring millions of times every day, but it is a fact which must be discerned and studied by an altogether different method from facts of crystallization, erosion, or plant growth. Psychology is not a science of inspection, but of introspection. If I know I am angry, I know it by a direct self-awareness; if I see a man strike another, and regard this as expressive of a psychosis, and that of a certain kind, anger, this supposed knowledge is analogical realization. One who never was or could be angry could no more investigate anger than a blind man light, and, other things being equal, the more irascible a man is, the better observer of anger he would be. We are not, however, conscious of all our mental processes, and we may be often blinded to the real nature of such we think we have; and as to the psychoses of other beings, especially of the more unlike and remote, we need to be extremely cautious in forming conclusions. It is likely that the mental constitution of organisms differ as widely as the physical, that the mentality of a fish is as diverse from our own as its physical structure is unlike our own. The fish may have peculiar psychoses of which we may never gain the least inkling, because we cannot examine its consciousness objectively as we do its fins, its air bladder, and its gills. The psychologist must then be myriad-minded;

his fitness is the ductility and range of his psychic capacity. The richness and receptivity of his own mental life must be infinite if he is to come to full knowledge of the whole course of psychism. Thus psychology is marked off from all other science as distinct in subject and method. Its being so individual and subjective is the greatest hindrance to its progress, for science is verifiable knowledge, but how shall we have a method of consciousness verification? A man tells me he has a scar on his left knee, and this I can verify by personal examination if I like, but if he says he is angry, I have no such means of verification, I can only guess by expression. A biologist announces the discovery of a pineal eye in a certain embryo, and straightway the fact may be verified by a host of observers; but if a psychologist announces that he has discovered a new mode of consciousness, the verification is by no means so easy. May not the consciousness be entirely peculiar to him? The psychologist who attempts to verify cannot disclaim the fact simply because he cannot find this act of mind in himself. But an introspective *consensus*, though extremely difficult as compared with the objective *consensus* required by objective science, is not impossible, but it requires exceptional gifts and training in introspection. Before psychology can reach any standing a method of subjective verification must be formulated and adhered to as rigidly as corresponding verification is required by objective science. The backwardness of psychology is in this most significant, that while a half-dozen recognised biologists may announce a certain fact, and it is immediately accepted as scientific knowledge, no such action can occur in psychology. The uncertainty of subjective verification is the trouble, and the most important step that can be made to-day is a clearly defined basis for an exact verification. That one party should claim there is a feeling of relation, and another that there is no such feeling, marks a crudeness in the most general matters, and points to psychology being about where physiology was when the circulation of the blood was in debate.

But, say the experimental psychologists, subjective verification is impossible; psychology, if it is to become a science, must, like the other sciences, resort to the laboratory, and by definite and exact

experiments produce the facts to order, study them by the most approved instruments, and obtain with certainty a knowledge of their laws. Now it is sufficiently easy to experiment on light, sound, and on plant growth in a laboratory, but how can we make consciousness to order with the same certainty? how can we know when we have got a consciousness, what kind it is, etc., except by subjective verification? You certainly cannot see the consciousness or touch it; but you must wholly rely on the subjective report of the individual experimented on as verified by your own consciousness. We have no impassive agent entirely under our control, except in hypnosis, and we cannot secure conditions with the same exactness in testing the intensity of some form of consciousness, as anger, as in testing the tensile strength of iron.

In the physical laboratory we produce certain conditions and we get invariably certain observable and measurable results, but in a psychological laboratory how shall I get with certainty a definite consciousness in a large number of cases and formulate its law? How shall I know at a given moment that the mental act of the agent is what my experiment requires? Moreover, does not experimental psychology by beginning with human consciousness enter rashly upon a very complex field? If it would get results, let it start with the simpler mental life, just as biology has founded itself in a study of simplest elements. But how shall psychology get at the consciousness of a clam with the same exactness as biology investigates the circulation of blood in the clam? It is plain, in short, that if we are to have a fruitful experimental psychology, some very important questions of method must first be settled. A method of getting psychoses to order, to obtain the exact reaction required, and knowing and realizing what it is when got, this is a *desideratum* not yet attained. Further, we must remark that experimentation is itself a psychic act, and sense of experimentation is a disturbing factor in results; that is, a consciousness which is conscious of being experimented on is thereby complicated over mere observation method. This is markedly the case in self-experimentation. Consciousness is not, like an electric current or a sound wave, an objective fact, readily reproducible in the laboratory. And again

ethics may interfere with psychical experiment. How far have we a right to incite psychosis for experiment's sake? How far may psychical vivisection be carried in the name of science? A scientist who should for his own study make an animal or person angry, would be reprobated as would the artist who should incite anger in his model in order to catch artistic effect. However, that there is a vast scope for experimental psychology cannot be denied, and we may expect an indefinite multiplication of artificial psychoses and combinations comparable to the artificial syntheses and new compounds of the chemical laboratory. Mind may develop and act merely on the scientific motive, and accomplish by *tour de force* a complex field of artificial consciousness quite distinct in origin and nature from natural consciousness. But for the present, at least, we regard not experiment but observation as the main method. Not laboratory, but field work, is most needed. The psychical scientist must go psychologizing, as the botanist goes botanizing. But there is no simple objective method as in botany. In order to have insight and interpretative power, there must be constant self-observation. He can know the real nature, conditions, and laws of other minds only so far as he realizes them in himself. If he has never feared, he will never know fear, and if he has never analyzed his own fear, he will not know its factors as occurring in others. All external consciousness is but a projection from the observer's own consciousness.

But it may be said that mind is but a kind of neural function, and that physiological psychology will give us the true key to consciousness. But if one has never known any psychosis, as fear, directly in himself and indirectly in others, how will he find it in any nerve activities? Nervous activities are significant of psychosis only so far as psychosis is already known. In fact, the sciences of neurosis and psychosis are radically distinct. I stick a pin in my finger, the facts of pain, volition, anger, etc., are of one order knowable only by introspection, the nerve excitation, current and reaction are of another order, constitute a complete circle, and are known only by inspection. Neurology in its own field can afford to ignore psychosis, for it does not find it: it finds only neural changes,

and psychology likewise can afford to ignore physiology. These sciences stand self-sufficient, and may develop indefinitely each in its own way without meeting. Divide and conquer. The present mingling of the two is greatly to be deplored. Thus in current books we often find such sentences as this: "The prevalent view hitherto has probably been that the same nervous apparatus which on moderate excitement produces sensations of pressure or temperature, produces feelings of pain when irritated with increased intensity." (Ladd, *Outlines Physiological Psychology*, p. 387.)

This confusing of objective and subjective terms, sensation and irritation, is but too frequent in recent treatises. There is no way yet found of discovering psychic facts in neural, or neural in psychic, whatever may be their connection and interdependence. If we must have a cross-interpretation, the psychologist has the vantage-ground on the basis of evolution by struggle. *Nisus* has developed all sense and motor organs and all nervous organs. It is the effort at seeing that has produced the optic nerve and the physiological function of sight. The vision and visual organ of the eagle came by incessant looking for prey during thousands of years. Hence mind is not reflex or concomitant of nerve, but nerve is outgrowth of mind in the struggle of existence, and a psychological physiology is better than a physiological psychology.

The psychological field is then first, self; second, other selves or individuals. In this latter phase of human psychology we have the psychology of adults, then adolescent, senile, infantile, sexual, and racial psychology. In sub-human or comparative psychology we include animals, wild and tame, also all discussion on plant psychism, mind stuff (*e.g.* Clifford's), etc. In superhuman psychology we include all doctrine of cosmic intelligence, teleology (*vide Mind*, x. 420).

We have limited ourselves to evolutionary psychology and that of the feelings, and our data are mostly from adult human consciousness. Evolutionary psychology bases itself on the idea that mental development originates and is continued through struggle or will effort. Such evidence as we can gather points to feeling, impelled exertion as the essence of psychic evolution, and it proves

fruitful when assumed as a guiding principle. And the principle of struggle is final. We cannot admit with Bain a principle of spontaneity. The activities of a new-born lamb are seemingly spontaneous only because they are the results of energies stored in ages of psychic effort. This doctrine of struggle does away with all impressionism and all passivity theories. Mind is not a receptivity, an association of impressions, a reflex or concomitant of physiological activities, but it is dynamic determining vital fact, an active response to the conditions of self-existence. This impetus of struggle and striving seems to feed all life and make life, and has its place, perhaps the highest in the dynamic whole we term the universe. While the significance of struggle is a question for philosophy, yet, as matter of fact, it is the only method of realization we know; and the office of humanity is the providing a wider and higher scope for struggle, the making new and independent life regions. Science and art, ethics and religion, which are at bottom only phases of emotionalism, are with utmost toil developed for themselves, and new emotions now arising and yet to arise will be cherished for their own sakes. Mind begins and continues long as the servant of the body, it ends by making the body its servant, the instrument of the spiritual life, the temple of the Holy Ghost; but all its evolution is through supreme effort. In the spiritual evolution he who loveth his life shall lose it, he whose struggle is in the primitive stage, namely, for material existence, loses thereby the real life, the life of the spirit.

It is possible, indeed, that we may over-estimate this salient fact of struggle, and certainly, in the present state of psychology, modesty is most commendable. We would be far from assuming that the horizon of our mind is the limit of the universe. However, assuming mind as a biological function continually evolving in the service of self-conservation and self-furtherance, our endeavour has been to point out the general trend of the evolution of feeling, and to analyze some of its more important features. The little exploration we have made suggests the greatness of the unexplored field of mind, the vast number of psychoses unknown, and perhaps unknowable. The difficulties of the subjective method make it seem

almost impossible to trace a complete history of mind. For mind to return over and realize its whole growth in all its ramifications seems quite as hard as to develop new forms, or a whole region of artificial psychosis. In the filling up of missing links, psychology presents vastly greater difficulties than biology because of its subjectivity of method and the evanescent nature of the facts. Further, the more I analyze consciousness, the more I am convinced of the great and often unexpected complexity of apparently simple forms, and I am satisfied then the simplicity and completeness of the system-making psychologists, physiological or idealistic, is factitious and delusive. An inductive science of mind is yet in its infancy. My conclusion that mind was at first, and is always as progressive, feeling-impelled will, and that sensing arose as secondary, as useful cognitive effort, is simply the best reading I can make from present data when assuming the current doctrine of evolution.

A very important point, which needs to be worked out more fully than we have been able to do, is as to the nature of revival as involving emotion. Sense of re-experience and of the experienceable is one of the most important acquisitions of mind. The self-consolidation and organization of experience certainly does not come in the first place by any mechanical association, but we must assume that all mental progress is the result of the most intense, though often blind and fortuitous striving. But just how the return of an experience is cognized as *return* and as *experience*, and so becoming basis for emotion, this is a most difficult inquiry on which we have made but a few remarks in the chapter on the nature of emotion. Just when and how sense of experience is generated, and what is a full analysis of its nature, must be postponed to some future study, but I am convinced that a very fruitful field for investigation lies in this direction. Experience certainly does at a very early stage become compound, become self-appreciative in some form, as sense of the potentiality of things, but the elucidation of progress in this line is confronted by many difficulties. The history of ideation or representation as a power for self-conservation has yet to be traced with definiteness and completeness.

Another point, which needs a far fuller discussion than we can now give, is as to the nature of organic interaction in consciousness, as to the real quality of psychic cause and effect. We have all along assumed feeling as stimulant of will, both the will to know and the will to act, but just how does feeling develop will as struggling effort? What is the exact mode of connection? We conceive readily of physical impact as determining effects in the material world, and we conceive a transference and transmutation of energy, but in the psychic realm we have no entities as permanent existences susceptible of entering into relation with other entities. How then does a pain incite a will activity? A peculiar form of consciousness we term will activity does directly follow upon feeling pain, and, within limits, the greater the pain, the greater the willing, but we have no theory to express the mode of connection of these consciousnesses. All that we can say is that one does follow upon the other as somehow caused by it. Yet it is certain that the limitation of conscious capacity must in every individual determine a definite range of interaction, and, beyond some particular point, the more I feel, the less I will, and *vice versâ*. But the phenomenon of interference is likewise as obscure as that of excitation. The development of distinct organic forms of consciousness is slowly carried forward, and they exercise a definite dynamic relation to each other, though the mode is as yet wholly obscure. Thus the largest subdivisions of consciousness, knowing, feeling, and willing, become determined as distinct organically related modes, like the nervous, nutritive-circulatory and motor systems forming one organic whole body. These psychic modes attain gradually an intricate and definite development, whose constant interdependent connection with an individual body we term a "mind." And we must remark that this vital relation of one consciousness and one form of consciousness to another is in no wise effected through apperception, through a third distinct consciousness, a cognitive one, which unites them in idea. A feeling excited a will act long before there was consciousness of either, or of their relation. In general we must say that consciousness does not consciously forge for itself its own relations, but that in by far the larger part of

psychic development new modes of consciousness and their inter-relations come in a totally unforeseen way, by a blind striving in the struggle for existence. It may be doubted, indeed, if even the most advanced human mind can really invent a new consciousness or a new relation in consciousness, but by intense effort it attains them. One of the obscurest points in biology is as to the nature and cause of morphological variation, and the subject of mental variation is for psychological science far more obscure. We presuppose that mental variations somehow arise in response to sudden and great emergencies, and in connection with the severest effort. Mental progress is, in all the earlier life at least, only achieved under pressure of intense pain actually experienced or ideally so,—emotion—and in some way an appropriate and saving psychosis as response of organism to environment originates. This new form may be indistinct, and proceed as a gradual differentiation from previous types, still the method of action of the motive force seems mysterious. We can see, indeed, the advantage which accrues, for example, to the animal which is first able to detect danger or nutriment by scent, but just the method of the rise and progress of scenting as a conscious process seems difficult to trace. We cannot say that power of smell arose because organs of smell were developed; this puts the cart before the horse. It is the struggle to sense that is the prime motive force in developing the sense organs and not *vice versâ*. We do not smell because we have noses, but we have noses because we smell. That the sense of smell is a differentiated general sensation is likely enough, but we are unable to follow the steps. We know that the higher development of our present senses is attained only through great exertion, which determines a physical basis and organic progress—as in microscopy, telescopy, and so-called mind-reading—and if humanity is to develop in the future an electric sense or a telepathic sense, it must be reached by the intense struggle of a very few. We must believe that every mode of mind is at bottom but some modification of pre-existing forms, and it may be that as all modes of the material are interpretable in motion, so the manifold mental may be equally resolvable into some one type. Yet so far as we can now see,

feeling, will, and cognition seem radically and primitively distinct. The missing links in mental evolution are most difficult to determine, for, as we have often remarked, while we can with comparative ease both determine fossil organic forms *a priori* and discover as realities, the intermediate mental forms can only be known through a subjective realization.

It does not help us to ascribe the advantageous variation to chance, a word, indeed, which does not belong to the dictionary of science, for it is but a cover to ignorance. Chance means that the determinate line of causes is hidden from the observer, who only knows that one of several results will take place. Chance is thus wholly relative; the gambling of savages is often calculable to the European, and so every affair of chance, as dice throwing, might be calculable to a superior intelligence who could compute or watch every turn of the dice. Chance, then, does not reside in the outward thing, is not a property of phenomena, but is wholly a subjective limitation of the investigating mind, hence to ascribe variation, physical or psychical, to chance is simply to objectivise our own imperfect cognition. The pre-supposition of all science is that every event or change has its definite determining antecedents, and that these are cognizable; hence the doctrine of chance has no place in any complete and real science of phenomena. That organism is, indeed, fortunate, which first achieves some notable and valuable psychic mode, but this good fortune does not in any wise come by chance, or by the passive enjoyment of concurrent favourable circumstances, but it is a well-earned superiority attained only by the severest and most patient responsive struggle, and there in every case a determinate series of steps in mental process which may ultimately be traceable.

Mental forms also arise through perversion, competitors perverting originally advantageous variations, as has been already pointed out for paralysing-fear, sense-destroying anger, etc. Atavistic tendency gives pseudo-variations. Certain mental forms may be negative in origin, that is, merely reactionary from previous states. Given a high degree of any joyous emotion, say hope, and suddenly remove its conditions, and the swing is back beyond the zero point of emotion

to actual negative emotion, as despair. Still the whole gamut from positive to negative, as from highest hope to deepest despair, is but a single generic emotion form of polar correlate elements, which have equally developed through struggle.

The subject of psychic intensity in general, and feeling intensity in particular, is likewise obscure and difficult. Physical intensity is comparatively easy to investigate in its nature and laws. For instance, in the case of light we clearly conceive its nature in terms of molecular motion, we measure it exactly by photometers, and we know it to proceed by the law of inverse squares. We have no similar certainty and clearness with regard to mental intensity. We speak of suffering very slight or very intense pains, but there is no scientific theory or valuation of psychic intensity. Mere physical intensity does not explain psychic, and we know that variations in rapidity of ether waves, for example, give, not quantitative, but qualitative psychic variations. 640 billion vibrations are felt subjectively as the comparatively feeble colour blue, while 450 billion gives the striking and intense colour, red. It is only within a certain range and with certain forms of forces that Weber's law of geometric and arithmetic increase applies.

Strictly speaking, we cannot apply quantitative conceptions to consciousness, inasmuch as mind has no spatiality which is the basis of idea of quantity and size. Hence the use of quantitative terms, like great, large, small, little, etc., is an indirect reference to intensity. I was in very great pain equals I was in very intense pain. No consciousness is literally either larger or smaller than another, because consciousnesses cannot, by reason of their non-spatial nature, enter into quantitative relations. So-called massive pains are really manifold. (See on this and kindred points my remarks in *Nature*, vol. 40, p. 642.)

A popular test of mental intensity, and one which has a relative value, is by the power needed to displace a given psychosis. Thus, if a man in a brown study walks into a pond of cold water without noticing it, we rightly conclude that he is thinking very intensely. This, of course establishes a scale relative to the individual, beginning with a psychosis which resists all displacing agencies, and

ending with those of such very slight intensity that they give way to any and all diversions. A consciousness which supplants another must *per se* be more intense than the other. All that which rouses and diverts patients suffering from monomania and fixed ideas is practically equal in intensity. While we may thus pronounce one state as being equal in intensity to another or as being more or less intense than it, we yet have no ground for any numerical estimate. When a person says, "I feel twice as bad as I did yesterday, or I feel a hundred times as happy now as I was a year ago," it is plainly a general and indefinite expression. Emotions have not yet been brought within the range of mathematical comparisons.

The intensity of feelings, as also of sensations, sustains undoubtedly certain mathematical relations to intensity of objective stimulus, but owing to their complex nature, emotions, at least, must always be very difficult of interpretation by any such law as Weber's, though simple pain may be brought more easily under some law. A pain, *other things being equal*, increases in some ratio to increment of physical stimulus. But we must believe that the reason for the diversity between proportion of actual increments of stimulus and actual increments of sensation and feeling is largely physiological. It certainly is not a true psycho-physical law, a law of relation of mind and matter, as is often claimed; for we cannot obtain an absolutely objective standard to test subjectivity. Hence any such law is merely a law of relation of different kinds of sensations, of different methods of interpreting the objective. Intensity of stimulus itself is always determinable only through some sensation, which is itself subject to Weber's law. There is no objective standard for sense stimuli; the measure of increasing stimulus to increasing sensation must be by some sense which has its own law with reference to physical increment as interpreted by another sense equally under law, and so on. Take pressure, for instance; we note by sense of *sight* the arm of a balance reacting regularly and constantly to definite small additions to load, while upon our own arm we do not notice the same additions in any such series of feeling of pressure increments. The arm and balance as disparate weighers must, of course, be in certain ratios related, and

for a certain range we must have a geometrical series, but other ratios at other points.

That the degree of sensitivity is proportioned to the intensity of sensation already present, that the knock at the door must be the louder the more noise is going on within, is a defect in organic measurement, but it is not entirely absent in mechanical; scales which weigh by the ton do not respond easily or at all to minute weights. But, abstractly speaking, mechanic methods are in general far superior to organic; a fine balance weighs better than any arm, and a good camera pictures better than the best eye; that is, their ratio of discriminating sensibility is far greater than natural organs, and it may be as geometric series to arithmetic series. Practically, however, organic weighing and seeing are well adjusted to the demands of life. An appreciation of gravity, so far as it is of use to the organism, is secured, and if a finer sensibility were demanded it would be attained. That is, I am inclined to believe that the Weber-Fechner law of definite mathematical proportions is purely empirical, and does not mark a real limit or a fundamental psycho-physical law. If a man's life and living depended on it, he could become a good weighing machine, and in time a race of organic weighers might be raised up which should vie in accuracy and range with the best scales now constructed. The quotient of sensitiveness is really indefinitely variable. It is probable, indeed, that deep sea organisms have a discriminative sensibility for both gravity and light far more delicate than the acutest human sense.

The whole subject of measurement of mental intensities must evidently be approached with the greatest care, and the diversities of researches in results and in their interpretation, is evidence that we have not completely isolated the facts we are in search of. Conscious experimentation must be allowed as tending to disturb sense. When attention is strained to marking sense increments it may very easily be deluded, and wrongly suppose as to feeling or not feeling. Consciousness is by no means infallible as to its own acts, and especially when artificial. Feelings may, and often do, originate subjectively by suggestion, and hence may have no direct

reference to the external cause which is under experimental manipulation.

And not only have we thus to guard against a strong tendency to introspective and apperceptive error as to what we actually experience, or how we experience, but we have also to constantly bear in mind that every experience, every sensing, as of pressure, light, etc., is not an isolated phenomenon, but as resting upon and involving the past, it can never be a simple direct measure of the objective present, as a given weight or light. Every conscious experience, like all other vital organic phenomena, has thus an individuality and differs from every other as every leaf differs from every other, and so the laws of experience are capable only of general expression. Since all consciousness is self-integrating and brings up the past into itself, it is always more than any occasional reflection of a present phenomenon; in the finest analysis every consciousness must have an equation of its own.

However, there is a quotient of relation of physical stimulus, mechanically measured, with increase and decrease of both sense and of pleasure-pain. The pack-carrier feels in a certain proportion to his present load pressure of weight-increments, and pressure pains also augment, though probably not in strict corresponding ratio. It is a popular saying that the last straw breaks the camel's back, and it is certain that pains rapidly culminate. It is probable that increments which may not be sensed may yet be felt as pain. In fact, it is but very gradually that sense of pressure is evolved as practically free of pain; as a mere cognitive process it is always secondary to pleasure-pain states which are felt directly from weights or but slightly objectified. Pleasure-pain which proceeds from weights gradually is driven to sensing them—the evolution of the pressure sense—and to noting variations, sense increments, and if, like marine organisms, we ranged through pressure zones, the significance of discriminative sensibility might be very great.

However, it is obvious that in its rise and in its whole evolution, pleasure-pain is bound up with the pressure sense, but not with the arm of the balance as a record. Hence it is possible that Weber's law, so far as applicable, is in some measure a result of feeling

interference. The simplicity of direct reaction is being destroyed by the hedonalgic law disturbing the direct ratio; we may thus feel an increasing pain from increasing weights, and have decreasing pressure sense. Beyond a certain point the law of increments, with reference to external standard for sensing and for pleasure and pain are in inverse ratio. On a very hot day we notice more and more strongly each additional degree of heat by the temperature sense, but beyond a certain degree, peculiar to the individual at the time, sense of heat will rapidly diminish as heat increases, and with increase of pain.

As to the number of feelings, of qualitatively distinct states, we must on a general doctrine of evolution pronounce this to be innumerable and indefinite. The present forms of feeling in human consciousness of course represent but a small fraction of the total number which have arisen in the course of psychic evolution. Every distinct form implies a long evolution of intermediate types which are now for the most part beyond our realization and so beyond cognition. The process of naming affords some slight clue to the importance and multiformity of feeling, though this denotes only a few of the most obvious points which have impressed themselves on the popular mind. Certainly the most striking fact to ordinary introspection, human and sub-human, is feeling, and the manifold variety of simple pleasure-pains and of emotions has always, and will always, attract most strongly the general attention. It would be a most interesting and profitable study to follow the course of language in its denotation of feeling. Varied expression for varied feelings is gradually achieved in vocal forms, which expressions become a language sense to denote the feeling expressed. Thus the hoarse bellow of rage will both express and denote rage. The vocal expression form as imitated is the earliest language form, and only very gradually does language assume the mechanical and arbitrary forms of its highest development. It is by imitating being mad vocally and otherwise, and pointing to the angered one, that the savage conveys the idea of anger. Gradually all but the vocal expression is dropped, and this conventionalized, becomes the origin of the word to denote the emotion in question. Feeling and emotion

names are doubtless in their origin debased vocal expression forms, though in the later evolution of language this is generally not detectable, and various other more indirect associations control language. Only states of consciousness which have attained a considerable force and prominence receive notice in the vocabulary of common speech. For many variances of feeling there is no word denotation, but it may be given by intonation. The number of names of feeling is thus in any language, or in all languages, but a very rough index to the actual number of kinds of feeling, and we may expect that a thorough scientific analysis will develop as extended scientific nomenclature of feeling, as chemistry has of kinds of matter. At the present crude stage of psychology we must affirm that the number of cognizable, but unnamed feelings, far exceeds the number of the named, and that the number of the undiscriminated or the undiscovered feelings far exceeds the number of both forms.

On the whole, it has been the object of our present studies to point out with some definiteness the extent and mode of the early differentiation of feeling. Owing to the peculiar difficulties which beset this form of study and to which we have often adverted, our conclusions may seem rather meagre and uncertain, but it is sufficient if they emphasize a region of introspective study, which, though of the utmost practical importance, is yet the most neglected of all in psychic science; and we hope to have set forth the most probable general order of mental evolution with some distinctness as based on the struggle of existence. Mind, beginning in pure pain, and culminating on the feeling side in the higher emotions, contains an intermediate, continuous, indefinite number of forms, determined by the demands of life and preserved by natural selection, many of which are so entirely outgrown that they may be for ever beyond human conception, and many occurring only occasionally in human consciousness as survivals, and a large, yet comparatively small number constituting the present evolution phase of feeling in human consciousness. We have dwelt specially on the lower developments, the rise of objectification and its nature, the rise and value of emotion, with some characterization of the simpler and earlier emotions. Emotion is superior to and supplants sensation, though

based thereon. The poison I fear, I abstain from without tasting; but with lower psychisms there must be a direct sensing of the thing before its experience quality is apprehended.

Must we not suppose that feeling and emotion is destined to be an evanescent form in the evolution of mind? Is not the emotional type gradually disappearing, and will not the men of the future be pure indifferentists? Or are we rather to judge that emotion will always continue to strengthen and deepen? In an intellectual and introspective age like our own the naïve mental life, which is primitive and merely natural, vanishes, and we find that men everywhere, like Kenyon, in Howell's novel, *The Undiscovered Country* are constantly destroying their feelings by pulling them up by the roots to see what they are and why they are. Such are only occasionally surprised into a genuine emotion, but they greet it with joy, and forthwith pull it to pieces in a morbid self-analysis. An indifferentism, born of intellectual curiosity, of scepticism or of pessimism, is, in fact, a pathological state, a certain mono-emotionalism, for humanity cannot escape emotionalism if it *would*. This *blasé* way of looking at things and *feeling* about them, is a decadent symptom in an artificial age. The struggle of life in a natural state always demands a varied, prompt, and frank emotionalism. If mind lose its love of things and men, it may yet be moved to highest attainment by sentiments like the love of science and truth. An intense intellectual life must be driven to its strugglings and achievements by some strong motive power, some powerful emotion, though this may be purely impersonal, like the conviction of duty, or the love of truth. Feeling as the fundamental element in mind, as the very core of mentality, as the force which actuates both will and cognition, can never be destroyed, and for the future progress of mind, as for the past, we are assured that feeling and emotion will not cease to become ever stronger, deeper, and nobler.

ERRATA.

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Transcriber's Note

Hyphenation is mostly consistent. The word 'representation' is frequently given as 're-presentation', as a technical term. Where the hyphen occurs at a line break, it is retained or removed based on other instances of the word in the text.

Errors deemed most likely to be the printer's have been corrected, and are noted here. The references are to the page and line in the original.

3.29	that feeling is a "strange[”] mysterious world	Removed.
4.19	through the [s]elf-observation of the human mind	Restored.
9.5	that it must[ ]be in consciousness	Inserted.
40.34	viz[.], of the neural basis	Added.
225.19	whether a pain[,] pleasure, perception	Inserted.
349.25	(*Expression of the Emotions in Man and Animals*, New York, 1886, p. 350[)];	Removed.
369.8	The interp[r]etation of expression	Inserted.

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